Code: 9A03401 **1**

II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012

KINEMATICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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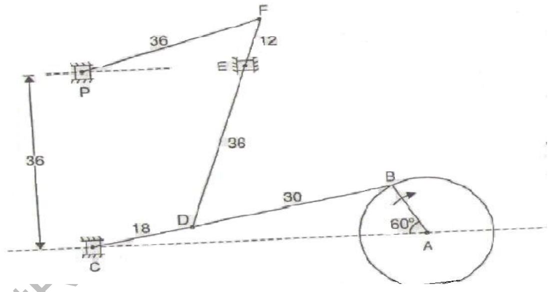
1 (a) Define and explain the terms: mechanism, machine, link and kinematic pair.

(b) Show that the locus of the midpoint of the link connecting the two sliders in an elliptical trammel is a circle.

2 What are straight line mechanisms? Describe one type of exact straight line motion mechanism with the help of a sketch.

3 In the steam engine mechanism, shown in fig the crank AB rotates at 200 r.p.m. Find the velocities of C, D, E, F, and P. Also find the acceleration of the slider at C. the dimension of the various links is: AB = 12 cm, BC = 48 cm, CD = 18 cm, DE =36 cm and EF =12 cm and FP= 36 cm.



4 (a) Describe with a neat sketch the working of Davis steering gear mechanism. Also prove that for Davis steering gear Tan α = w/2 L.

(b) Two shafts with an inclined angle of 160˚ are connected by a Hooke's joint. The driving shaft runs at a uniform speed of 1500 r.p.m. The driven shaft carries a flywheel of mass of 12 kg and 100 mm radius of gyration, find the maximum angular acceleration of the driven shaft and the maximum torque required.

5 A flat ended valve tappet is operated by a symmetrical cam with circular arcs for flank and nose profiles. The total angle of action is 150º, base circle diameter 125 mm and the lift 25 mm. During the lift, the period of acceleration is half that of the retardation .Speed of cam shaft is 1250 r. p. m. The straight line path of the tappet passes through the cam axis .Find: (i) Radii of the nose and flank, and

(ii) Maximum acceleration and retardation during the lift.

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6 (a) Define the term: 'Length of arc of contact' and prove that it is equal to length of path of contact divided by cosine of the pressure angle.

(b) The number of teeth on each of the two equal spur gears in mesh is 40. The teeth have 20º involutes profile and the module is 6 mm. If the arc of contact is 1.75 times the circular pitch, find the addendum.

7 A flat belt 8 mm thick and 100 mm wide transmits power between two pulleys running at 25 m/ s. the mass of the belt is 0.9 kg/m length. The angle of lap for the smaller pulley is 165º and coefficient of friction is 0.30 the maximum permissible stress for the belt material is 2×10^6 N/ m^2. Calculate the maximum power that can be transmitted.

8 (a) What do you mean by gear train? Mention the different types of the gear train.

(b) In an epicyclic train an annular wheel A having 54 teeth meshes with a planet wheel B which gears with a sun wheel C, the wheels A and C being co-axial. The wheel B is carried on a pin fixed on one end of arm P which rotates about the axis of the wheels A and C. if the wheel A makes 20 r.p.m. in a clockwise sense and the arm P rotates at 100 r.p.m. in the anticlockwise direction and the wheel C has 24 teeth, determine r.p.m and sense of rotation of the wheel c.

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1 (a) Define and explain the term kinematic chain. For a kinematic chain, what is the relation between number of pairs and number of links? Also write the equation, showing the relation between number of links and numbers of joints.

(b) What do you mean by constrained motion? What are the different types of constrained motions? Explain each type with examples neat sketches.

2 Give a neat sketch of the straight line motion Hart mechanism. Prove that it produces an exact straight line motion.

3 (a) Prove that the ratio of the angular velocities of the driven and driving shafts for a Hooke's joint is given by $\omega_2/\omega_1 = \cos\alpha / 1-\cos^2\theta \ \sin^2\alpha$.

(b) What is the condition for correct steering? Sketch and show the two main types of steering gears and discuss their relative advantages.

4 A tangent cam with a base circle diameter of 50 mm operates a roller follower 20 mm in diameter. The line of stroke of the roller passes through the axis of cam. The angle between the tangential faces of the cam is 60º, speed of the cam shaft 250 r.p.m and the lift of the follower 15 mm. calculate:

(a) The main dimension of the cam

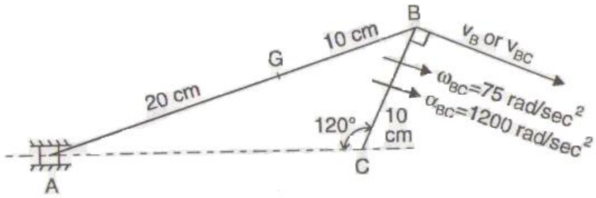
(b) The accelerations of the follower at

(i) The beginning of the lift.

(ii) Where the roller just touches the nose.

(iii) The apex of the circular nose.

5 A reciprocating engine mechanism is shown in figure the crank CB = 10 cm and connecting T rod BA = 30 cm with the center of gravity G, 10 cm from B. In the position shown, the crank has a velocity of 75 rad/s and an angular acceleration of 1200 rad/s2. Find: (a) The velocity and acceleration of G and (b) the angular velocity and angular acceleration of AB.



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6 (a) What do you mean by pitch point; circular pitch; module, addendum and dedendum of a gear?

(b) Calculate: (i) length of path of contact, (ii) arc of contact and (iii) contact ratio when a pinion having 17 teeth drives a gear having 49 teeth. The profile of the gear is in volute with pressure angle 20º, module =6 mm and addenda on pinion and gear wheel =1 module.

7 (a) What are the relative advantages and disadvantages of chain and belt drives?

(b) Derive the expression for optimum speed of flat belt for the transmission of maximum power considering the effect of centrifugal tension.

8 (a) What are the advantages of epicyclic gearing?

(b) An internal wheel B has 80 teeth and is keyed to a shaft F. A fixed internal wheel C with 82 teeth is concentric with B.A compound wheel DE gears with two internal wheels, D having 28 teeth and gears with C, while E gears with B. the compound wheel revolves freely on a pin which projects from a disc keyed to a shaft A, co- axial with F. if all the wheels have the same pitch and the shaft A makes 800 r.p.m., what is the speed of F?

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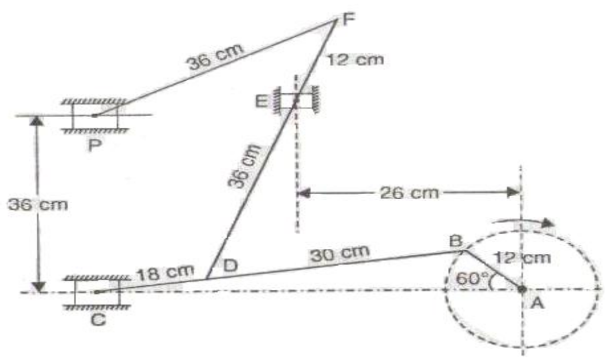
1 What do you mean by inversion of a mechanism? Explain with sketches any three inversions of single slider crank mechanism. Where these inversions are used?

2 Draw the sketch of a mechanism in which a point traces an exact straight line. The mechanism must be made of only revolute pairs. Prove that the point traces an exact straight line motion.

3 Derive an expression for the ratio of shafts velocities for Hooke's joint and draw the polar diagram depicting the salient features of driven shaft speed.

4 In a steam engine mechanism, shown in fig, the crank AB rotates at 200 r.p.m. the dimension of the various links are : AB = 12 cm, BC = 48 cm, CD =18 cm DE= 36 cm and EF = 12 cm and FP = 36 cm, Find the velocities of C, D, E, F and P.



5 (a) Define and explain the terms:
(i) cam profile (ii) base circle (iii) prime circle (iv) pitch curve (v) lift and period of dwell.

(b) The following particulars refer to a cam with concave flank, circular nose and roller follower. Base circle diameters =80 mm, distance between nose circle and cam axis = 58 mm nose radius = 26 mm, concave flank radius =60 mm. Follower roller radius =10 mm, speed =10 rad/s semi angle of action =60°. Determine the velocity and acceleration for the follower when the cam has rotated by 25° from the initial position of the rise of the follower.

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6 (a) Prove that for two involutes gear wheels in mesh, the angular velocity ration does not change if the centre distance is increased within limits, but the pressure angle increases.

(b) The numbers of teeth on each of the two equal spur gears in mesh are 40. The teeth have 20^o involutes profile and the module is 6 mm. If they are of contact is 1.75 times the circular pitch, find the addendum.

7 (a) Distinguish between initial tension and centrifugal tension in a belt.

(b) The power is transmitted from a pulley 1 m diameter running at 200 r.p.m. to a pulley 2.25 m diameter by means of a belt. Find the speed lost by the driven pulley as a result of the creep, if the stress on the tight and slack side of the belt is 1.4 N/mm2 and 0.5 N/mm respectively. The young's modulus for the material of the belt is 100 N/mm.

8 An arm A carries 4 gear wheels B, C, D and E. Gear wheel B meshes with gear wheel C and gear wheel D meshes with gear wheel E. Gear wheels C and D form a compound gear. The number of teeth on gear wheel B = 20, that on gear wheel C = 15, that of gear wheel D = 35 and gear wheel E has 20 teeth. If the speed of arm is 100 r. p. m. clockwise and gear wheel E is fixed, calculate the speed of gear wheel B. Draw the sketch of the gear train.

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(Mechanical Engineering)

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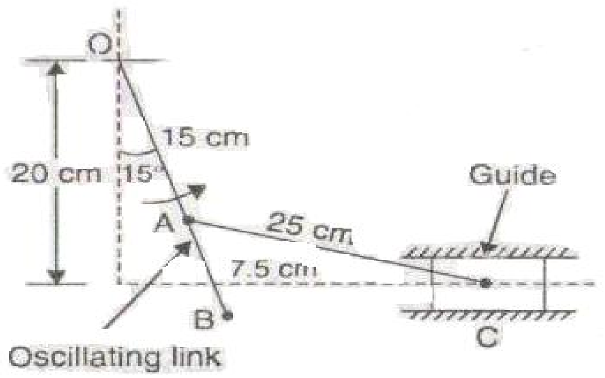
1 (a) Sketch a pantograph, explain its working and show that it can be used to reproduce to an enlarged scale a given figure.

(b) A circle has OR as its diameter and a point Q lines on its circumference. Another point P lies on the line OQ produced. If OQ turns about O as centre and the product OQ × OP remains constant, show that the point P moves along a straight line perpendicular to the diameter OR.

2 (a) What do you mean by inversion of a mechanism? Explain.

(b) Explain the following:
(i) Scotch Yoke mechanism, (ii) Elliptical Trammel, and (iii) Oldham's coupling.

3 The oscillating link OAB of a mechanism shown in figure is pivoted at O and is moving at 90 r.p.m anti- clockwise. If OA= 15 cm, AB= 7.5 cm and AC= 25 cm, then calculate: (i) the velocity of the block C, (ii) angular velocity of the link AC and (iii) the rubbing velocities of the pins at O, A and C assuming that these pins are of equal diameter of 2 cm. the oscillating link OAB makes an angle of 15 with the vertical as shown in fig.



4 (a) What is fundamental equation of steering gears? Which steering gear fulfils this condition?

(b) A Hooke's joint connects two shafts whose axes intersect at 18°. The driving shaft rotates at a uniform speed of 210 r.p.m. the driven shaft with attached masses has a mass of 60 kg and radius of gyration of 120mm. Determine (i) the torque required at the driving shaft if a steady torque of 180 N.m resists rotation of the driven shaft and the angle of rotation is 45°. (ii) The angle between the shafts at which the total fluctuation of speed of the driven shaft is limited to 18 rpm.

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5 (a) What do you understand by the terms cam and follower? Name the essential members of a cam mechanism.

(b) Draw full size profile of a cam which will lift a 2.5 cm diameter follower through 4 cm. the centre line of the follower passes through the centre of rotation of the cam. Ascent of follower takes place with S.H .M. in 0.1 second, followed by a period of rest of 0.025 sec. the follower then descends with uniform acceleration and retardation in 0.075 second. The cam rotates at a uniform speed of 120 r.p.m. And the least radius of the cam is 10 cm. Also plot velocity and acceleration diagrams of the follower during one revolution of the cam and mark important values thereon.

6 A pair of gears, having 40 and 30 teeth respectively is of 25^{o} involute form. The addendum length is 5 mm and the module pitch is 2.5 mm. If the smaller wheel is the driver and rotates at 1500 r.p.m. find the velocity of sliding at the point of engagement and at the point of disengagement.

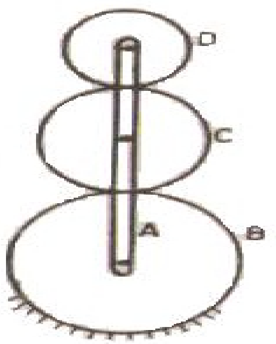
7 (a) Derive an expression for the ratio of tensions for a flat belt passing over a pulley, when it is just on the point of slipping.

(b) Two parallel shafts 12 meters apart are to be connected by a belt running over pulleys of diameters 480 cm and 80 cm respectively. Determine the length of the belt required if the belt is open.

8 (a) Describe the procedure of calculating the fixing torque in case of fixed wheel in case of an epicyclic gear train.

(b) An epicyclic gear train is shown in figure. Find out the r. p. m of pinion D if the arm A rotates at 60 r.p.m in anticlockwise direction. Number of teeth on wheels are given below :

$T_B = 72$; $T_C = 60$; $T_D = 40$



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